each Waelz kiln or electrothermic furnace, as applicable to your facility, including documentation of any materials excluded from Equation GG–1 of this subpart that contribute less than 1 percent of the total carbon inputs to the process. You also must document the procedures used to ensure the accuracy of the measurements of materials fed, charged, or placed in an affected unit including, but not limited to, calibration of weighing equipment and other measurement devices. The estimated accuracy of measurements made with these devices must also be recorded, and the technical basis for these estimates must be provided.

§ 98.338 Definitions.

All terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

Subpart HH—Municipal Solid Waste Landfills

§ 98.340 Definition of the source category.

(a) This source category applies to municipal solid waste (MSW) landfills that accepted waste on or after January 1, 1980.

(b) This source category does not include hazardous waste landfills, construction and demolition landfills, or industrial landfills.

(c) This source category consists of the following sources at municipal solid waste (MSW) landfills: Landfills, landfill gas collection systems, and landfill gas destruction devices (including flares).

§ 98.341 Reporting threshold.

You must report GHG emissions under this subpart if your facility contains a MSW landfill and the facility meets the requirements of § 98.2(a)(1).

§ 98.342 GHGs to report.

(a) You must report CH_4 generation and CH_4 emissions from landfills.

(b) You must report CH_4 destruction resulting from landfill gas collection and combustion systems.

(c) You must report under subpart C of this part (General Stationary Fuel Combustion Sources) the emissions of CO_2, CH_4, and N_2O from each stationary combustion unit following the requirements of subpart C.

§ 98.343 Calculating GHG emissions.

(a) For all landfills subject to the reporting requirements of this subpart, calculate annual modeled CH_4 generation according to the applicable requirements in paragraphs (a)(1) through (a)(3) of this section.

(1) Calculate annual modeled CH_4 generation using Equation HH–1 of this section.

$$G_{CH4} = \left[\sum_{x=S}^{T-1} \left\{ W_x L_{0,x} \left(e^{-k(T-x-1)} - e^{-k(T-x)} \right) \right\} \right] \qquad \text{(Eq. HH-1)}$$

Where:

G_{CH4} = Modeled methane generation rate in reporting year T (metric tons CH_4).

X = Year in which waste was disposed.

S = Start year of calculation. Use the year 50 years prior to the year of the emissions estimate, or the opening year of the landfill, whichever is more recent.

T = Reporting year for which emissions are calculated.

W_X = Quantity of waste disposed in the landfill in year X from tipping fee receipts or other company records (metric tons, as received (wet weight)).

L_0 = CH_4 generation potential (metric tons CH_4/metric ton waste) = MCF × DOC × DOC_F × F × 16/12.

MCF = Methane correction factor (fraction); default is 1.

DOC = Degradable organic carbon from Table HH–1 of this subpart or measurement data, if available [fraction (metric tons C/metric ton waste)].

DOC_F = Fraction of DOC dissimilated (fraction); default is 0.5.

F = Fraction by volume of CH_4 in landfill gas from measurement data, if available (fraction); default is 0.5.

k = Rate constant from Table HH–1 of this subpart or measurement data, if available (yr^{-1}).

(2) For years when material-specific waste quantity data are available, apply Equation HH–1 of this section for each waste quantity type and sum the CH_4 generation rates for all waste types to calculate the total modeled CH_4 generation rate for the landfill. Use the appropriate parameter values for k, DOC, MCF, DOC_F, and F shown in Table HH–1 of this subpart. The annual quantity of each type of waste disposed must be calculated as the sum of the daily quantities of waste (of that type) disposed. You may use the bulk waste parameters for a portion of your waste materials when using the material-specific modeling approach for mixed waste streams that cannot be designated to a specific material type. For years when waste composition data are not available, use the bulk waste parameter values for k and L_0 in Table HH–1 of this subpart for the total quantity of waste disposed in those years.

(3) For years prior to reporting for which waste disposal quantities are not readily available, W_X shall be estimated using one of the applicable methods in paragraphs (a)(3)(i) through (a)(3)(iii) of this section. You must determine which method is most applicable to the conditions and disposal history of your facility and use that method to estimate waste disposal quantities.

(i) Assume all prior year waste disposal quantities are the same as the waste quantity in the first reporting year.

(ii) Use the estimated population served by the landfill in each year, the values for national average per capita waste generation, and fraction of generated waste disposed of in solid waste disposal sites found in Table HH–2 of this subpart, and calculate the waste quantity landfilled using Equation HH–2 of this section.

$$W_x = POP_x \times WGR_x \times \frac{\%SWDS_x}{100\%} \qquad \text{(Eq. HH-2)}$$

Where:

W_X = Quantity of waste placed in the landfill in year × (metric tons, wet basis).

POP_X = Population of served by the landfill in year × from city population, census data, or other estimates (capita).

WGR = Average per capita waste generation rate for year x from Table HH–2 of this subpart (metric tons per capita per year, wet basis; tons/cap/yr).

%SWDS = Percent of waste generated subsequently managed in solid waste disposal sites (i.e., landfills) for year × from Table HH–2 of this subpart.

(iii) Use a constant average waste disposal quantity calculated using Equation HH–3 of this section for each year the landfill was in operation (i.e., from first accepting waste until the last year for which waste disposal data is unavailable, inclusive).

$$WAR = \frac{LFC}{(YrData - YrOpen + 1)} \qquad \text{(Eq. HH-3)}$$

Where:

WAR = Annual average waste acceptance rate (metric tons per year).

LFC = Landfill capacity or, for operating landfills, capacity of the landfill currently used from design drawings or engineering estimates (metric tons).

YrData = Year in which the landfill last received waste or, for operating landfills, the year prior to the first reporting year when waste disposal data is first available from company records, or best available data.

YrOpen = Year in which the landfill first received waste from company records or best

available data. If no data are available for estimating YrOpen for a closed landfill, use 30 years as the default operating life of the landfill.

(b) For landfills with gas collection systems, calculate the quantity of CH_4 destroyed according to the requirements in paragraphs (b)(1) and (b)(2) of this section.

(1) If you continuously monitor the flow rate, CH_4 concentration, temperature, pressure, and moisture content of the landfill gas that is collected and routed to a destruction device (before any treatment equipment) using a monitoring meter specifically for CH_4 gas, as specified in §98.344, you must use this monitoring system and calculate the quantity of CH_4 recovered for destruction using Equation HH–4 of this section. A fully integrated system that directly reports CH_4 content requires no other calculation than summing the results of all monitoring periods for a given year.

$$R = \sum_{n=1}^{N}\left((V)_n \times \left[1-\left(f_{H20}\right)_n\right] \times \frac{(C)_n}{100\%} \times 0.0423 \times \frac{520^{o}R}{(T)_n} \times \frac{(P)_n}{1\ atm} \times 1{,}440 \times \frac{0.454}{1{,}000} \right) \quad \text{(Eq. HH-4)}$$

Where:

R = Annual quantity of recovered CH_4 (metric tons CH_4).

N = Total number of measurement periods in a year. Use daily averaging periods for continuous monitoring system (N = 365). For weekly sampling, use N = 52.

n = Index for measurement period.

$(V)_n$ = Daily average volumetric flow rate for day n (acfm). If the flow rate meter automatically corrects for temperature and pressure, replace ''520 °R/$(T)_n$ × $(P)_n$/1 atm'' with ''1''. If the CH_4 concentration is determined on a dry basis and the flow rate meter automatically corrects for moisture/content, replace the term [1 − $(f_{H_2O})_n$] with 1.

$(f_{H_2O})_n$ = Daily average moisture content of landfill gas, volumetric basis (cubic feet water per cubic feet landfill gas).

$(C)_n$ = Daily average CH_4 concentration of landfill gas for day n (volume %, dry basis). If the CH_4 concentration is determined on a wet basis, replace the term [1 − $(f_{H_2O})_n$] with 1.

0.0423 = Density of CH_4 lb/cf at 520 °R or 60 °F and 1 atm.

$(T)_n$ = Temperature at which flow is measured for day n (°R).

$(P)_n$ = Pressure at which flow is measured for day n (atm).

1,440 = Conversion factor (min/day).

0.454/1,000 = Conversion factor (metric ton/lb).

(2) If you do not continuously monitor according to paragraph (b)(1) of this section, you must determine the flow rate, CH_4 concentration, temperature, pressure, and moisture content of the landfill gas that is collected and routed to a destruction device (before any treatment equipment) at least weekly according to the requirements in paragraphs (b)(2)(i) through (b)(2)(iii) of this section and calculate the quantity of CH_4 recovered for destruction using Equation HH–4 of this section.

(i) Continuously monitor gas flow rate and determine the cumulative volume of landfill gas each week and the cumulative volume of landfill gas each year that is collected and routed to a destruction device (before any treatment equipment). Under this option, the gas flow meter is not required to automatically correct for temperature, pressure, or, if necessary, moisture content. If the gas flow meter is not equipped with automatic correction for temperature, pressure, or, if necessary, moisture content, you must determine these parameters as specified in paragraph (b)(2)(iii) of this section.

(ii) Determine the CH_4 concentration in the landfill gas that is collected and routed to a destruction device (before any treatment equipment) in a location near or representative of the location of the gas flow meter no less than weekly.

(iii) If the gas flow meter is not equipped with automatic correction for temperature, pressure, or, if necessary, moisture content:

(A) Determine the temperature, pressure in the landfill gas that is collected

and routed to a destruction device (before any treatment equipment) in a location near or representative of the location of the gas flow meter no less than weekly.

(B) If the CH_4 concentration is determined on a dry basis, determine the moisture content in the landfill gas that is collected and routed to a destruction device (before any treatment equipment) in a location near or representative of the location of the gas flow meter no less than weekly

(c) Calculate CH_4 generation (adjusted for oxidation in cover materials) and actual CH_4 emissions (taking into account any CH_4 recovery, and oxidation in cover materials) according to the applicable methods in paragraphs (c)(1) through (c)(3) of this section.

(1) Calculate CH_4 generation, adjusted for oxidation, from the modeled CH_4 (G_{CH_4} from Equation HH–1 of this section) using Equation HH–5 of this section.

$$MG = G_{CH4} \times (1 - OX) \qquad \text{(Eq. HH-5)}$$

Where:

MG = Methane generation, adjusted for oxidation, from the landfill in the reporting year (metric tons CH_4).

G_{CH4} = Modeled methane generation rate in reporting year from Equation HH–1 of this section (metric tons CH_4).

OX = Oxidation fraction. Use the default value of 0.1 (10%).

(2) For landfills that do not have landfill gas collection systems, the CH_4 emissions are equal to the CH_4 generation (MG) calculated in Equation HH–5 of this section.

(3) For landfills with landfill gas collection systems, calculate CH_4 emissions using the methodologies specified in paragraphs (c)(3)(i) and (c)(3)(ii) of this section.

(i) Calculate CH_4 emissions from the modeled CH_4 generation and measured CH_4 recovery using Equation HH–6 of this section.

$$\text{Emissions} = \left[\left(G_{CH4} - R \right) \times \left(1 - OX \right) + R \times \left(1 - \left(DE \times f_{Dest} \right) \right) \right] \qquad \text{(Eq. HH-6)}$$

Where:

Emissions = Methane emissions from the landfill in the reporting year (metric tons CH_4).

G_{CH_4} = Modeled methane generation rate in reporting year from Equation HH–1 of this section or the quantity of recovered CH_4 from Equation HH–4 of this section, whichever is greater (metric tons CH_4).

R = Quantity of recovered CH_4 from Equation HH–4 of this section (metric tons).

OX = Oxidation fraction. Use the oxidation fraction default value of 0.1 (10%).

DE = Destruction efficiency (lesser of manufacturer's specified destruction efficiency and 0.99). If the gas is transported off-site for destruction, use DE = 1.

f_{Dest} = Fraction of hours the destruction device was operating (annual operating hours/8760 hours per year). If the gas is destroyed in a back-up flare (or simlar device) or if the gas is transported off-site for destruction, use f_{Dest} = 1.

(ii) Calculate CH_4 generation and CH_4 emissions using measured CH_4 recovery and estimated gas collection efficiency and Equations HH–7 and HH–8 of this section.

$$MG = \frac{R}{CE \times f_{Rec}} \times (1 - OX) \qquad \text{(Eq. HH-7)}$$

$$\text{Emissions} = \left[\left(\frac{R}{CE \times f_{Rec}} - R \right) \times \left(1 - OX \right) + R \times \left(1 - \left(DE \times f_{Dest} \right) \right) \right] \qquad \text{(Eq. HH-8)}$$

Where:

MG = Methane generation, adjusted for oxidation, from the landfill in the reporting year (metric tons CH_4).

Emissions = Methane emissions from the landfill in the reporting year (metric tons CH_4).

R = Quantity of recovered CH_4 from Equation HH–4 of this section (metric tons CH_4).

CE = Collection efficiency estimated at landfill, taking into account system coverage, operation, and cover system materials from Table HH–3 of this subpart. If area by soil cover type information is not available, use default value of 0.75 (CE4 in table HH–3 of this subpart) for all areas under active influence of the collection system.

f_{Rec} = Fraction of hours the recovery system was operating (annual operating hours/8760 hours per year).

OX = Oxidation fraction. Use the oxidation fractions default value of 0.1 (10%).

DE = Destruction efficiency, (lesser of manufacturer's specified destruction efficiency and 0.99). If the gas is transported off-site for destruction, use DE = 1.

f_{Dest} = Fraction of hours the destruction device was operating (device operating hours/8760 hours per year). If the gas is destroyed in a back-up flare (or similar device) or if the gas is transported off-site for destruction, use f_{Dest} = 1.

§ 98.344 Monitoring and QA/QC requirements.

(a) The quantity of waste landfilled must be determined using mass measurement equipment meeting the requirements for commercial weighing equipment as described in ''Specifications, Tolerances, and Other Technical Requirements For Weighing and Measuring Devices'' NIST Handbook 44 (2009)(incorporated by reference, see § 98.7).

(b) For landfills with gas collection systems, install, operate, maintain, and calibrate a gas composition monitor capable of measuring the concentration of CH4 in the recovered landfill gas using one of the methods specified in paragraphs (b)(1) through (b)(6) of this section or as specified by the manufacturer. Gas composition monitors shall be calibrated prior to the first reporting year and recalibrated either annually or at the minimum frequency specified by the manufacturer, whichever is more frequent, or whenever the error in the midrange calibration check exceeds ± 10 percent.

(1) Method 18 at 40 CFR part 60, appendix A–6.

(2) ASTM D1945–03, Standard Test Method for Analysis of Natural Gas by Gas Chromatography (incorporated by reference, *see* § 98.7).

(3) ASTM D1946–90 (Reapproved 2006), Standard Practice for Analysis of Reformed Gas by Gas Chromatography (incorporated by reference, *see* § 98.7).

(4) GPA Standard 2261–00, Analysis for Natural Gas and Similar Gaseous Mixtures by Gas Chromatography.

(5) UOP539–97 Refinery Gas Analysis by Gas Chromatography (incorporated by reference, see § 98.7).

(6) As an alternative to the gas chromatography methods provided in paragraphs (b)(1) through (b)(5) of this section, you may use total gaseous organic concentration analyzers and calculate the methane concentration following the requirements in paragraphs (b)(6)(i) through (b)(6)(iii) of this section.

(i) Use Method 25A or 25B at 40 CFR part 60, appendix A–7 to determine total gaseous organic concentration. You must calibrate the instrument with methane and determine the total gaseous organic concentration as carbon (or as methane; K=1 in Equation 25A–1 of Method 25A at 40 CFR part 60, appendix A–7).

(ii) Determine a non-methane organic carbon correction factor no less frequently than once a reporting year following the requirements in paragraphs (b)(6)(ii)(A) through (b)(6)(ii)(C) of this section.

(A) Take a minimum of three grab samples of the landfill gas that is collected and routed to a destruction device (before any treatment equipment) with a minimum of 20 minutes between samples and determine the methane composition of the landfill gas using one of the methods specificed in paragraphs (b)(1) through (b)(5) of this section.

(B) As soon as practical after each grab sample is collected and prior to the collection of a subsequent grab sample, determine the total gaseous organic concentration of the landfilll gas that is collected and routed to a destruction device (before any treatment equipment) using either Method 25A or 25B at 40 CFR part 60, appendix A–7 as specified in paragaph (b)(6)(i) of this section.